

## WORKS TRANSPORT AND SHIPPING IN A LARGE ENGINEERING FACTORY.

*Paper presented to the Institution, Manchester Section,  
by A. Mycoe.*

**I** ESTEEM it a great honour to-night to have the opportunity of addressing such an Institution as yours, and, in the short time at my disposal, I will endeavour to give you an insight into the transport problem as it affects a large engineering concern.

I contend that works transport, packing, and shipping for both home and abroad are very closely allied with each other, and very large savings can be effected if these problems are studied jointly, and I have, therefore, included them in my paper.

The design and construction of the product affect both the cost of packing and the cost of shipment, more particularly if intended for export, and, later, you will no doubt be interested in the many ways this affects your industry.

The question of giving the customer a good article rests with the design and production engineers, and if you could only see what happens to your goods when received and loaded aboard ship, or man-handled by native labour, or dumped on site, you would wonder how the material lived through the many movements or handlings.

I propose to deal with the subject under the following headings :

- (1) *Site of the Factory* (siding agreement); (2) *Works Transport* (internal); (3) *Packing* (home and abroad); (4) *Cost of Shipment* (home and abroad, including marine insurance).

I have included in my paper the question of the "Site of the Factory," for I have found in the past that the siding agreement has not had serious consideration when being drafted or arranged. This agreement is drafted by the railway company with regard to the working of your siding, maintenance, etc., and should contain definite arrangements in connection with service charges and allowances.

The siding may be laid on your land or the railway company's and, if the latter, you would in all probability be called upon to bear the expense, or you may pay the siding rent. It is not generally realised that the tonnage of the material received through the siding is much greater than the tonnage shipped, as the tonnage received may be four times the tonnage forwarded (it may even be considerably greater where fuel for power generation is included).

I would point out that 95 per cent. of the rail-borne goods traffic to-day is carried at special rates, many of which rates may cover

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for services that, in fact, may not be performed by the railway company, and consequently, the siding agreement should clearly state the rebates to be allowed in lieu of services not performed. You will, therefore, appreciate the necessity of arriving at definite arrangements with the railway company.

Some years ago I was on a committee set up to examine quite a number of siding agreements. In one or two instances the siding agreement had been signed without due consideration, in fact, in one particular instance, under a very old agreement, the company had agreed to pay the local town rates, and were by no means receiving the rebates to which they were entitled. It was found possible to negotiate a new agreement, and to obtain a refund over a period of years that well paid for the trouble involved. The works had grown out of all proportion from the original size, and undoubtedly the trader should have negotiated a new agreement.

The position of the works can also be a distinct advantage; you may, for instance, be situated near a large port, which, in addition to providing cheap facilities for export shipments also enables you to make considerable use of the special rail rates applicable thereto. The trader has the right of appeal to the Railway Rates Tribunal in connection with any difficulties which may arise regarding siding agreements (Section 61, Railway Act, 1921).

### Works Transport—Internal.

The internal works transport of a large factory is undoubtedly a most important factor, and I could easily spend the whole of the evening discussing this question. We should soon be involved in a discussion regarding the merits of conveyor belts, etc., but I must keep to my subject, and that is, if transport is considered necessary, how it can best be catered for by mechanical means.

I have operating control of battery trucks and petrol trucks of many types, and last, but not least, hand trucks and horse carts. I find that the battery tractor type truck gives the best all round service for workshop use, particularly by using it in the form of a train. They are able to move and turn easily in the shop gangways and lifts, and have the advantage of being quiet and free from exhaust fumes.

*(A picture on the screen showed the formation of the train, and it could be seen that the tractor particularly is of such a nature that it is very easily manoeuvred and can push wagons or trucks into position.)*

The tractors are worked on definite routes or circuits, and, except at the main crossings, keep to their own circuit. The centre wheels of the truck are slightly raised, and the couplings are arranged in such a manner that by a pull on the chain a right-angle turn can be effected, thus avoiding the necessity of cutting a corner. Different

types of trucks are used, designed to meet the traffic requirements of the various departments, box bogies, flat trucks, refuse bins and trucks fitted with spring trays for delicate apparatus. The petrol type Fordson and Lister trucks are used for dealing with heavy material, outside the factory, over soft ground on which a battery truck could not operate so satisfactorily.

Extensive use can also be made of an internal railway track, where available, for conveying large pieces from the foundry and other feeder department, by loading in box type and flat top wagons. In connection with small apparatus it is undoubtedly an advantage, and also more economical to effect transport by auto direct to store, or direct to the section where the material is required. Small traffic which is to be centralised is transported (already packed in the department manufacturing) to the main shipping warehouse for shipment or storage. Large pieces of apparatus can, of course, be loaded direct into the railway wagon or lorry where desirable.

The question of elimination of movement is a matter which requires continual consideration, and, from a production point of view, it is essential that a full inquiry is made into all movements, with a view to saving cost and avoiding transport. In my opinion a plant can be over-mechanised, and in some departments a labourer may prove to be a key-man for the whole department, probably controlling output and production to a large extent, and, even where a belt or conveyor is installed, human agency for sorting out different classes of goods and articles for different jobs may still be necessary. The Fordson Tractor (petrol type) meets certain conditions namely, rough roads, and bad ground, particularly if used in conjunction with ordinary four-wheeled lorries (trailer types) or small low heavy transport bogies. Particular attention must be paid to the fact that the tractor must not stand waiting to be loaded and unloaded. They must be kept on the move, and run to various sections for the transference of material on stand trailers or lorries.

### **Packing.**

Packing, apart from the necessity of being satisfactory from a sales point of view, must be viewed in conjunction with the cost of shipment, both for home and abroad.

*Home Transport.*—Packing must be considered together with the method of transport, as, for example, extra charges, if any, paid for road transport may be saved several times over by reduced costs for packing, dismantling, and re-erection. Experience gained by the introduction of road transport has shown the possibility of effecting savings in many directions and has also led to the introduction of containers by the railway company, now used in thousands. Savings effected in connection with freight charges, no small item, must not be overlooked, nor must the cost of returned empties, which in addition

to the cost of recording are a source of annoyance to customers.

The introduction of non-returnable cardboard cartons or plywood boxes for small articles should be considered for two reasons: (1) The freight packed in non-returnable boxes, compared with the cost of a returnable box; (2) If the article is manufactured in large quantities, considerable advantage is gained by using the road motor or container, without packing. Meters are shipped all over the country in cardboard boxes, and the saving in freight alone (i.e., the gross weight chargeable) more than pays for the box, which, from a production point of view, cleanliness and expeditious delivery is far more satisfactory than the old method of shipping in heavy returnable wooden cases.

I am of course, referring to small shipments, which because of their weight have to go forward direct from the works to customer. If sent to a store or branch, there is no necessity for outer cartons to be used, and shipments can be effected in bulk to the local depot in a container, or by road transport.

*(Here the lecturer showed a chart giving details of the savings made by this method.)*

The freight alone saved by this method of packing will be a handsome contribution to your distribution costs at the local depot. Owing to the low freight costs obtained by bulk shipment it is being developed considerably, and the railway companies are now prepared to distribute from your local depot to a destination many miles away by road motor. They have instituted what is known as the "railhead scheme" and are prepared to effect delivery to a point many miles away at very reasonable costs, which gives you the advantage of cheaper freight, and saving in packing.

*(The lecturer gave examples of applications of the scheme and described the organisation.)*

The railway companies are alive to the packing side of the industry, but I still think that they have room for many improvements that would go a long way to eliminate packing costs, and put them in a better position in some instances than the road carrier.

There are many conditions in connection with packing in railway companies' classifications, which, from time to time are introduced to avoid claims for breakages in transit. Thickness of the cardboard is specified, together with numerous clauses regarding the actual method of packing machinery. These conditions are necessary to a certain extent due to the methods of handling and transport, and, in connection with the latter particularly, I think that the railway companies should make an endeavour to obviate shunting and the continuous shocks due to the make-up of the train, and do away with loose couplings. It is pleasing to note that more and more vacuum brake fitted express goods trains are being put into service, and I feel sure that these will minimise the risk of damage.



The containers supplied by the railway companies vary in types, they undoubtedly save packing, and are being extensively used. I can foresee a time when practically every goods wagon will be designed in a way to overcome the necessity of handling.

*(Slides were shown illustrating several types of containers, each specially designed for certain classes of goods.)*

The railway companies have inaugurated a small charge for the use of these containers, which they term "differentials" and which varies according to the class of material, and, whilst I do agree with the principles of this charge, there are nevertheless, many ways and means of avoiding it.

In my opinion, the charge should have some relation to the net weight of the material, and where it is possible to load to the full carrying capacity of the container, no extra charge should be incurred. I admit that the container to-day is carrying material of a light bulky nature, which never passed by road motor (the road man requires weight) and in this case the railway company is probably justified in making a small charge. The "differential" varies from five per cent. to 20 per cent. depending on the class of goods. I could quote many varied types of packing but the main factor to bear in mind is the handling the consignment will be subject to during transit. If the consignee has siding connections he can make the wagon the container, for this eliminates handling.

### Road and Rail Bill.

Much has been said in the Press regarding the Road and Rail Bill, which will become law in 1934, and probably most people are wondering exactly what it all means. I feel that we are bound to agree that the existing state of affairs in connection with road transport could not have been allowed to develop without legislation of some kind or other being resorted to.

The Bill has three main functions : (1) Proper regulation of the road transport industry ; (2) More effective control of hours of labour, etc. ; (3) Economic division of transport between two main forms of transport.

In my previous remarks, I have perhaps given you the impression that I am railway minded, or, in other words, that I place implicit faith and reliance in the railway companies. I must say, however, that the railway companies have undoubtedly driven a great deal of traffic to the road people due to slackness and, whilst a certain amount of the present competition is largely due to lack of foresight and development, I think that they have been labouring under difficulties due to their inability to overcome their "statutory powers" with regard to charges. Whilst they have made considerable improvement in connection with service and charges during the past two years, they had, in my opinion, good grounds for appealing

to the Government for investigation, as a result of which the Road and Rail Bill was passed.

Trouble has been caused mainly by what, to the initiated, is known as the "Back Loader," and it may interest you to know some of the methods employed in order to obtain a return load. Road clearing houses have been instituted in practically every town, and use is made of any motor available on the return load principle. Cut rates are quoted to the public for return loads.

I would point out that there is a certain section of the Road and Rail Bill which has given rise to a great deal of discussion and also a certain amount of misapprehension. Under this particular section, the railway companies have the power to make whatever charges they wish, and whilst there is an element of danger in this clause, the general public cannot expect to have the benefit both ways. The road people were at liberty to charge any figure they considered suitable, and compelled the railway companies to carry such traffic as they themselves were unable to convey on account of the low classification, thus taking the cream of the business.

The question of licences is one which will have to be carefully watched in trade interests. Licences will be granted to the road contractor for the weight which he had on the road on January 1st, 1932, for a period of two years, after which application will have to be made to the Traffic Commissioner. Experience with the Traffic Commissioner in connection with transport services licences for passenger transport suggests that the private individual may have difficulty when applying for a licence, in view of the fact, that in all probability objections will be raised by the railway companies, tramway companies, and other large corporations.

### **Packing for Export.**

I remarked in my introduction on packing on the necessity for adequate packing, which, in connection with foreign shipments cannot be stressed too much. It is very unsatisfactory to the customer to receive broken material after having waited for your product for many months.

The question of packing for export shipment calls for special attention with a view to avoiding breakages, damage by water condensation and shrinkage of timber, but the main item I wish to stress to-night is the cubic measurement of the material when packed, or, what is commonly referred to as "ocean tons." The steamship companies charge on weight or measurement, at their option, and if the measurement is greater (40 cubic feet = one-ton weight), the steamship company has the option of charging on the measurement.

The design and construction of the article, if intended for export, can have a great bearing on the freight costs, and where possible the design should facilitate packing in the smallest possible space,

and the parts should be strong enough to be packed satisfactorily without too much soft packing or floating material. Considerable improvements in design have been effected by the introduction of fabricated welded or pressed steel parts to replace the parts formerly made of cast iron. Fabricated or pressed steel parts frequently have greater strength than similar parts of cast iron and require less packing, being only about half the weight of cast iron parts. This means very great savings in the cost of freight.

The shipment of a large stator for export, of welded construction, compared with cast iron, shows in some instances a saving of between £200 and £300. I would, however, like to draw your attention to the other side of the picture and remind you that in welded construction for export the question of measurement must not be overlooked, for instance, if welded stands and supports of channel iron are designed without special regard to transport, charges for freight may be very heavy indeed.

In the case of abnormally large pieces, a drawing should be submitted to the shipping departments for approval of weights and dimensions with a view to ascertaining whether or not the crane facilities are adequate, and also whether the load will pass the loading gauges. It also should be decided how the plant or machine should be shipped, whether in one piece or dismantled. In some instances you may decide to ship assembled, but in most cases, where possible, it is to your advantage to ship dismantled.

An essential part of the equipment of an efficient traffic department is the possession of full information in connection with port charges and crane facilities for different foreign ports, together with the loading gauges of each country, as in many instances the packing must be designed specially to meet the gauge and loading conditions abroad.

*(As an example a picture was shown of a large rotor for shipment to South Africa, weighing 40 tons, packed to suit the loading gauge and special wagons used on the South African railways. The base of the skid, or case, was removable to enable the rotor to be suspended over the track and the piece was protected from flying pebbles by a steel plate. The top was also chamfered and covered by a plate to enable the load to pass under the bridges.)*

The following is an instance which will illustrate the necessity for the packing and freight to be considered jointly. In connection with a large contract for the Hungarian State Railway, published particulars of which have interested practically all the carriers in the world, the cheapest route, so far as freight was concerned, was undoubtedly to ship by steamer from Manchester to Bremen, Bremen to Regensburg by rail, and Regensburg to Budapest by barge via the Danube. The handling, however, would have been very severe for electrical machinery, and the packing would have

needed to be of a very robust nature. The alternative method of avoiding packing was to endeavour to arrange shipment by the G.E. Train Ferry, via Harwich and Zeebrugge and, after lengthy negotiations, it was arranged for the L. & N. E. R. and train ferry wagons to be loaded at Trafford Park and forwarded by train ferry to Budapest—a matter of 1,300 miles in seven to ten days, delivery being effected to site in perfect condition.

The motors weighed 30 tons each, and the transformers  $26\frac{1}{2}$  tons each in addition to general switchgear.

*(A photograph showed the switchgear, together with porcelain bushings containing oil, loaded on an English trolley.)*

This material arrived on site ready for putting straight into commission.

Had any other method than train ferry been adopted, the bushings would have had to have been packed in special cases and floated in wood wool in other cases in order to withstand transit conditions.

Some little trouble was experienced at the commencement of exporting this material in persuading the Belgian Authorities to accept some of the special wagons, due to the fact that the flanges of the wheels were rather badly worn. We had been advised that it was absolutely essential for the wheels and flanges of the trucks to be in good condition. The trains on the Continent are vacuum fitted, and arrangements had to be made to fit the trolley with piping, etc., to enable the wagons to travel in the middle of a goods train. These negotiations occupied a considerable time, and, had we not had ample time prior to delivery, I am afraid that shipment by train ferry could not have been effected. When the railway companies received an inquiry in connection with this particular contract, they seemed to have very little idea of the continental charges, and the contract figures received in the first instance, were right out of the picture. By bringing in agents experienced in Continental business, however, it was found possible to obtain rates at less than half the original quotation.

There are great possibilities in connection with effecting shipment of material abroad via train ferry, and it is surprising to me that this method has not been adopted more extensively. I must emphasise the necessity of close contact between the design engineer, the production engineer, and the shipping department, and hope that the discussion will show that this important section of my lecture has aroused the interest it merits.

### **Cost of Shipment.**

*Home.*—I maintain straight away that there is ample scope in this country for all kinds of transport: road, rail and water, and they should each be allowed to operate through the country to the advantage of the community in general. Manufacturers naturally wish to deliver goods by the most reasonable method to themselves,

with due consideration to speed of transport, distribution, and adequate packing.

The railway companies have undoubtedly not been in a position to quote rates in competition with those quoted by some of the road people, particularly the "Back Loader," but they are now, or very soon will be, able to quote whatever figure they wish for your traffic (Road and Rail Bill, Part II, Clause 29). They have, however, been meeting certain traders for some time by giving them a contract figure for a complete shipment or even for a whole plant or product, although they had not the power to do so. I have found that, for the last two years, the railway companies have tried to meet the traders in many respects, and, I must say that we cannot do without the railways.

*(Slides were shown describing the railway companies' charges relative to various classes of goods.)*

I have mentioned, in my previous remarks, "inward materials," and the slide will, I hope, give you some idea of the low rates prevailing in connection with raw materials generally. The railway companies would, undoubtedly, be justified in increasing these charges, maintaining that they are not having a fair deal in view of the fact that the road people were only prepared to deal with a high class of goods, or, in other words, wished to pick and choose what goods they would carry, whereas the railway companies, being common carriers, were compelled to take whatever was offered to them.

The railway companies are carrying 95 per cent. of their tonnage at special rates, and, in all cases, it is policy to obtain contract figures or special rates in competition with road and water transport. I contend that it is justifiable to ask for and receive a special rate for a five ton load.

The "classification" of material is a statutory document divided into 21 clauses, printed by the authority of Parliament, and cannot be altered without the sanction of the Rates Tribunal. It is a most interesting document, and traffic can be divided up in many ways with a view to obtaining a lower classification. The decision whether or not a particular commodity shall be in this or that class has been arrived at automatically and each succeeding classification has followed the framework of its predecessor. Where a number of classes have been enlarged, this has been done by sub-division of the older class. The main principle, however, in arriving at the railway companies' charges, has been based on "what the traffic will bear." Material, however, must be described in classification terms, if the correct rates are to be obtained; for instance, certain parts of machines and machinery are divided into classes varying from 9 to 19.

If, in comparison with others, the material appears to be in too

high a class, a formal application should be made by the trader through the Railway Clearing House, to the interested railway companies for re-classification, good use being made of the "road bogie." Personally, I have always found that they were at all times prepared to give due consideration to an application.

I think you will be interested to see the actual pictures of certain transformers, large stators, and other "out of gauge" loads, which have necessitated special arrangements in connection with conveyance, and have called for the use of specially constructed wagons, which, in some instances, have been built to the manufacturer's design.

A transformer for the Central Electricity Board was loaded on a special type of truck which, by means of side girders, enabled our design engineers to load a transformer of much greater dimensions than previously was the case (i.e., when loaded on the old type of well trolley). The truck was constructed to our requirements and enabled the transformer to be loaded within 7-ins. of the rail. Unfortunately in this country there is no standard loading gauge for the railway companies generally and each one differs slightly, both in height and width. This proved a difficulty during the early negotiations in connection with the National Electricity Scheme, and when it was decided to publish specifications governing the size of all transformers for the grid scheme, it was discovered that the limitations of this gauge were such that it was impossible to proceed with the scheme, and the matter was left entirely to the trader to make his own arrangements with the railway company, or to adopt other means of transport.

A stator for shipment to Japan became wedged in the tunnel between Chester and Birkenhead. The weight was considerably over 50 tons, and was out of gauge both in height and width. To cut a long story short, the railway companies had repeatedly refused to deal with this load, but, later, on account of the amount of traffic they had lost to road, it was decided to make some attempt to effect delivery of this consignment.

We were fully aware at the time that it would be a "close shave" and exciting incidents were experienced en route, and, at the commencement of the journey the awnings over the platform at Old Trafford were destroyed. Eventually, however, the consignment arrived safely at Helsby, near Chester.

The traffic was then handed over to the Great Western and London, Midland and Scottish Railway Companies jointly, when objections were raised because the dimensions, when loaded, were found to be different than stated, due to the variation in the springing of the wagons. The load was then transferred to the L. & N. E. Railway Company, who were most anxious to give



every assistance, and conveyance was continued in sections, using the block system of signalling, as the opposite road had to be clear.

Eventually, we arrived at the tunnel previously mentioned, and the load just cleared the arch but, due to the fact that there was a rise in the track, which veered slightly to the platform side, the truck lifted and the material was wedged in the middle of the tunnel. It was then necessary to bring out the breakdown gang, and the track was moved slightly to the centre of the tunnel to allow the load to pass through. Up to that time the railway companies had lost a considerable amount of revenue to road competition on this type of consignment, and the experience gained in this instance has enabled them to accept many similar loads. I may say that the conveyance of "out of gauge" loads generally, call for a great deal of special attention on the part of the railway companies.

In another case, an 80-ton stator loaded on a special trolley necessitated over 42 movements over two Sundays, for which more than 300 special working notices were issued. These notices are absolutely necessary, as no other load can pass on the opposite line during the conveyance of a special piece. I would also say that, due to road competition, the railway companies have in many instances, had to waive the special working charge.

The collapse of a wagon loaded with a transformer caused the transformer to slide along the track for about 400 yards, luckily, however, no serious damage was done other than the loss of oil due to the fracture of a valve. The chairman is quite familiar with this load, and I think he would like me to mention that this proved a good advertisement for the welded tank.

Some of you may inquire why bulky consignments are not forwarded by water, to which I would immediately reply that the costs for crange alone from Manchester to London, if shipment were effected by water, would be considerably in excess of the freight by road.

*Overseas.*—I cannot possibly deal with this matter fully to-night and will confine myself to the freight and insurance side of the business, having already dealt with packing for export. The freight rates quoted by the steamship companies are controlled by the conference lines, or steamship companies operating to that territory and, in a somewhat similar way to rail, are based on "what the traffic will bear." The material is also classified, but, unfortunately, so far as the general public is concerned, the classifications are not published, although various trade organisations have from time to time made every endeavour to obtain copies. I do recommend that, in connection with all large contracts the question of special rates is taken up with the steamship companies.

In doing this, however, it is generally policy to consult all the interested steamship companies; as it is advisable for each company.

to have had the case submitted to them individually prior to meeting in conference. I have found them very considerate and usually prepared to meet the trader to some extent. A point I would stress is that it is particularly important for negotiations in this connection to be dealt with whilst the contract is in the tender stage, and *not* after the order has been secured, otherwise the steamship companies are inclined to think that you are using them as a means of obtaining additional profit.

I have previously referred to the question of cubic measurement during my remarks in connection with packing, and I would point out that there is a surcharge scale in operation, for packages weighing over two tons (in some cases one ton). The scale generally increases the charge 5s. per ton; that is, if the rate is 90s. per ton, two tons would be 95s. and three tons 100s., etc. You will now appreciate the need for consideration in connection with dismantling prior to shipment.

In my opinion, some of these scales must have been inaugurated in the days of Queen Elizabeth, when it was necessary for the material to be manhandled, but, in these days of modern machinery, and especially in view of the fact that the majority of steamers have lifting gear which will deal with pieces up to 10 tons, I consider that it is an imposition. This matter has been repeatedly brought to the notice of the steamship companies, but, at the present moment, there is little hope of this surcharge being brought to the level of the railway companies' scale (the surcharge operates on the railway companies over 12 tons).

I pointed out previously that the steamship companies charge weight or measurement, their option, but for one market the surcharge on pieces *measuring over two tons* compared with a piece *weighing over two tons*, is considerably less, so that in the case of a large piece or pieces, for once in a way, you must make the package "measurement."

*For example:*

Case weighing 30 tons	...	90s. per ton extra
Case measuring 30 tons	...	365s. " " "
Total difference	...	£412 10 0.

We have had one or two cases for this territory, and I remember one instance; where it was thought we were putting too much timber on a certain job—you can buy a lot of timber for £412.

When quoting overseas markets, it is essential that one is familiar with all port charges involved, and also that contract conditions are such that certain additional charges are avoided, which otherwise might affect your estimate considerably.

The question of marine insurance is one that I find is not appreciated to the full extent; this is most important, and I strongly recommend that the insurance policy should cover all risks (including

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breakage, fresh-water and sea-water damage) and also from warehouse to warehouse, and not for total loss (marine only). In addition to being fully covered you have the advantage of sending your material by rail at owner's risk and thereby obtaining cheaper rates. The owner's risk rates in South Africa give a big reduction in freight, and if damage occurs in transit a claim can be made against the insurance company (if covered warehouse to warehouse). Had the material been consigned company's risk, in most cases damage could not have been proved on rail, and the railway company would, no doubt, refuse to accept liability.

In conclusion, I trust that I have been neither too brief nor too lengthy in my talk, and I shall be glad to give you any further information that may be in my power to supply.

## Discussion.

MR. T. FRASER (Section President, who presided) : I think you will agree, after hearing Mr. Mycoe's talk, that there are many problems—probably more than most of us realise—in connection with transport. It seems to me that it is a subject that has been much overlooked and I consider that it is up to all of us to take much more notice of transport when considering costs. Concerning rebates, it seems that the railway companies are doing something regarding cheaper rates than standard, and that being the case, we ought to do something about getting these rates, but from Mr. Mycoe's remarks it would seem that no one less than a Philadelphian lawyer could get the reductions. I think we have got to thank the road transport for the position we are in to-day. They are getting the railways to talk sense. I can go back some years and remember some of Mr. Mycoe's talks with the railway companies. The railways then were so autocratic you could do nothing with them, and but for the road transport we would still have been in the same position. I think it is for the common good. Quite recently I have travelled up to London over-night by road—and if you have not done so, just take a trip and see the amount of road transport there is. It is astonishing—goods and passenger traffic all the night through. Regarding the condition under which articles arrive on site, I have had some experience of this. We packed some parts of machinery for India and thought they could stand anything. When they arrived in India the things were all smashed to pieces. Having in mind the condition in which this type of machinery for India is handled we carried out very severe tests on these cases before they were dispatched. It is a difficult question in these days of competition. The cost of packing alone is as much as an article is worth, and until the railway and steamship companies get down to it, we shall always be in trouble.

MR. MYCOE : With regard to rates, it is, as the chairman has indicated, always a question of the road transport against the rail. We are now able to get special rates from the railway company within twenty-four hours ; at one time we could not have got it within twenty-four weeks. With regard to road transport, this bears on the question of road clearing houses. There are thousands of them all over the country, and the business generally is peculiar to the trade. I would compare a certain type of road haulier with a tramp steamer, as they are willing to go anywhere at any time, and are absolutely in the hands of the road clearing houses, who, after deducting various sums for different services performed, leave very little for the owner-driver. These men are often without sleep for

weeks at a time, and snatch a few hours rest by the roadside in the early hours of the morning when things are quiet. The Ministry of Transport, however, have now realised that these practices should be stopped. Regarding special rates, I make a point of converting the daily precis of orders into tonnage, and give each railway a copy. The railway companies now realise what road transport means and know that it is up to them to give us satisfactory rates.

MR. A. FRASER : May I ask if certain companies have special rates ? I have a recollection of reading a short while ago in the newspaper that certain companies, say, large companies, are allowed a special preferential rate over that of smaller concerns. Is that quite true ? Is a large company allowed a cheaper rate than, shall we say, a smaller company in the same district, though both companies may be delivering the same class of goods to the same district ?

MR. MYCOE : By law the railway companies are not allowed to give preferential terms to one trader over another. Any small trader can get the same rate by getting a contract figure. (Mr. Mycoe quoted the case of the Hungarian State Railway job.) Next year the railways will be able to quote any trader whatever they like.

MR. ECKERSLEY : I am rather disappointed that Mr. Mycoe did not mention more of the transport side of the works—the inter-departmental transport. Most of us are concerned with that rather than the delivery of the goods to the customer. I think that kind of transport depends to a large extent on the layout of the shop. A single storey building can use a different method of transport to that used in a building requiring lifts. In our works we use lifter trucks used in conjunction with boxes with legs on them. The boxes are designed in such a way as to hold different types of components and we find them very useful. As the components are finished we place them into the boxes, lift them and transport to the assembly department. I consider that a lot of transport difficulties in works could be solved by judicious selection of suitable trucking arrangements.

MR. MYCOE : I particularly kept away from the question of lifting trucks, skips, platforms, and things of that nature, because I knew I could take up the whole evening discussing the matter. I do think, as you say, that works' transport generally depends entirely on the design of your factory. With a single storey building, for most products you can use a lifting truck with advantage for moving the parts from one machine to another. Where you get traffic from factory to factory, I can picture a train being the most economical.

MR. LESLIE : I would like to ask Mr. Mycoe's opinion on the question of horse transport as compared with motor transport. I have in mind rather heavy cartage and short deliveries. In regard

to export shipments, I think some clearer explanation of the ocean tonnage would be of advantage to us, and I should like to ask what arrangements Mr. Mycoe has to make for the handling of the material at the other end. I have in mind that, supposing we have a large contract, we are up against a penalty on the other side. It seems to me that we can get considerable charges in penalty or perhaps in wharf charges and local storage unless some through arrangements are made.

MR. MYCOE: Regarding horse transport, this will develop considerably in view of the high taxation, but horse transport is not used for long distances, but where a man is a long time loading and unloading it is more economical. For instance, the railway companies find that at the back of Piccadilly it is more economical to put a horse lorry on the job rather than the more expensive motor lorry. With regard to tonnage, the steamship companies charge on weight or measurement, at their option, and if the measurement is greater (40 cubic feet = one ton) the steamship companies have the option of charging on measurement. Regarding port arrangements, that is a matter that has developed from experience. Take for instance a South African shipment. You have your own agents at the various ports whom you have found very alive and active and fair in their charges but it is necessary to find out from time whether they are acting in your best interests or not. You probably have your own office there. It is advisable to keep a watch on them—you can easily pay a few hundred of pounds a week penalty by not clearing the large pieces from the port. We have to keep well advised of the arrival of these pieces.

A SPEAKER asked a question regarding extra charge for rails which had to be loaded into the bottom of the boat as they were heavy—9,000-ton boat had to go to Liverpool to collect these rails and then go back to London to collect light material to go above. How would that be charged?

MR. MYCOE: It all depends on the tonnage they were getting and the arrangements with regard to freight. A lot of ships are now calling at Newport for sheet iron, which is being put at the bottom of the ship for ballast.

A SPEAKER asked if Mr. Mycoe would be good enough to give the exact meaning of F.O.B. Does it include crange charges?

MR. MYCOE: I know exactly what you have in mind—it is the Russian question. A Russian interprets F.O.B. as free on board. He wants it on board. He is not concerned with what charge is the steamer's and what is the dock charge—in other words—the custom of the port does not interest him. On shipments for overseas generally, crange is a steamer's charge—to the "man in the street" it can be interpreted as putting free on board. On the steamers, however, that ply between this country and Europe, crange is not



looked upon as a steamer's charge and as part of the F.O.B. The Russian, however, is not concerned with the customs of any port, and he interprets the wording "free on board" as including all charges over the ship's side, and as some of the charges over the ship's side are included in the stowage of the vessel, this, to my mind, is not a charge for placing F.O.B.—and this is the sole cause of the trouble. The only thing to do is to have your conditions of sale so worded as to enable you to overcome the difficulty. It is a very delicate question to tackle, and my advice is: do not pay any charge for stowage.

MR. HUGHES: There are two small matters that I would like to mention. The first is that Mr. Mycoe told us that railway rates were statutory and could not be altered, and yet, if I am not greatly mistaken, he told us also that 90 per cent. of the rates to-day are special rates. With regard to F.O.B., it has always been known with regard to this that the legal rendering of it meant that a piece of machinery or anything else is on board ship when once it is over the side, no matter whether it is in the crane, in the hold or on the deck. If it is in the air in the crane, so far as the legal sense of it goes it is on board and our liability if we are loading F.O.B. ceases. We had an instance concerning a piece that we were sending to Australia a few years ago, in Salford Docks. When they got it over the side of the ship something went wrong with the crane and the piece slipped and went on the deck and did considerable damage. We inspected it at Salford, saw it was not necessary to bring the case back to the works, so we sent it to Liverpool for repair, after which it was shipped. But we never got any claim from the steamship company because they knew that legally once that was over the ship's side it was their responsibility. That is only one instance; I could give you many more. If I am wrong, perhaps Mr. Mycoe will put me right.

MR. MYCOE: Railway rates are statutory. The 95 per cent. special rates are applicable for any particular trade. Regarding the question of F.O.B. charges, cramage on any piece is always the steamer's charge. The legal interpretation as mentioned by Mr. Hughes "over the ship's side" is held in a court of law. It includes cramage but not on the Continent. It is quoted separately on the Continent. For ocean-going steamers cramage is a steamer's charge. The legal interpretation would be "which side of the ship did it drop on?"

MR. FRASER (Chairman): The point is not quite clear. Take a piece of machinery shipped from Liverpool to Australia and the rates quoted are F.O.B. Have you any additional charge to get that piece on the steamer?

MR. MYCOE: F.O.B. charges include canal tolls and other inci-

dental charges at the port. Sea freight to Australia would include crantage.

MR. FRASER: If we were in Australia and ordered a piece of machinery and want it F.O.B.—we say we will take care of it. You would call that ordinary F.O.B. and we would take the piece delivered on board and after that we have got to take it in hand. Would you have anything to pay over and above the rate quoted?

MR. MYCOE: Haulage and dock dues.

MR. CROOKE: There is one very important point which the lecturer has not touched upon to-night. It is a point which affects machine tool makers, textile machine makers, or printing machine makers, and it is this: When you have carefully packed machinery for overseas, no matter how carefully you grease it, rustproof it, etc., you are very lucky if it arrives at the other end without contact with sea air or sea water. How can you make sure that every part of a machine would arrive at its destination without being affected? Arising out of Mr. Leslie's question: We are manufacturers of rather heavy machinery—the weights ranging from six to 30 tons. We have to dismantle every machine we export, and whether it is abroad or whether it is to a different part of the country, quite a lot of it goes by rail. Now, take a heavy machine weighing 30 tons for London which has to be erected on a fourth floor—the railway company cannot have a wagon standing in the street all day long, with side frames, and so on, left lying about for a considerable time, and I believe there is some arrangement whereby you can arrange for packing into so many sections—first, second, third, and fourth deliveries—and the railway company will arrange to deliver as and when required. Are there special charges for machines delivered under those conditions?

MR. MYCOE: With regard to damage by sea water or fresh water, I dealt with insurance very briefly indeed, but in connection with overseas' shipments you can get an all-risk policy to insure for all damages by fresh or sea water, warehousing, etc. All these points are well covered. There is also the possibility of effecting some better means of protecting from rust. We have tried all sorts of rust preventatives and we find that the best is Lanoline—special Lanoline, which has proved satisfactory. Shaft parts can be protected, in addition, by sheet lead, prior to which they should be rested in wooden skids. White lead or tallow can also be used in this connection. It is a difficult thing to find a perfect scheme. The only thing you can do is to felt-line your cases, and ask your agent to take particular care. We have had to take this question up severely with our agents abroad for not having the wagons sheeted. Some of the foreign railways—also the colonies—make a special charge for sheeting the wagons, otherwise they are sent up country unsheeted. Regarding the point in respect to delivering consignments in sections

to facilitate erection, this can be done without any extra charge. It is a matter to arrange before you send traffic away ; you should make it a condition. My experience is, do not let charges get raised on the job ; deal beforehand and get them cleared up.

MR. ECKERSLEY : Some years ago we had a lot of trouble with parts going rusty. At the time we were delivering to China and in an attempt to overcome this trouble we obtained about six samples of different Lanoline solutions. We took six different lots of components, packed them into six separate cases, and each lot of components was packed in a different way, with different solutions, and we trans-shipped these to China. The ship returned to this country without unloading the six cases. Examination of the contents of the cases after their eight months trip revealed to us the best of the different Lanoline solutions which had been used, and the most efficient packing method, from the point of view of rust-prevention.

MR. A. FRASER : Could Mr. Mycoe give me some idea as to the demurrage charge for wagons lying in the yard over certain periods ?

MR. MYCOE : Demurrage charge is the charge the railway company raise after forty-eight hours on your premises. We are dealing with 100 wagons a day and the demurrage bill for the last two or three months has been only a matter of £3 or £4. It is necessary to answer your question in a roundabout way. You get a wagon in on Monday loaded and it is not unloaded until Wednesday—a day's demurrage. If you load that wagon out on Friday you are free of demurrage. Now, we operate the yard economically and the running of it is left entirely to the shunter and he gets a slight bonus. (Mr. Mycoe described the method used with tag-on labels.)

MR. PUCKNELL : I am particularly glad that we have had this talk to-night, as it tends to show production engineers how far from complete the job is when it is finally assembled. Production engineers must be thankful that there is such a person known as the traffic agent, because I am sure that production engineers, as a class, would be far too highly moral to ever be successful as traffic agents ! Our chairman spoke of the wisdom of a Philadelphian lawyer—to me it is a glorious wangle ! I have three questions to ask : How are goods packed in these railway containers ? What in Mr. Mycoe's opinion is the best form of transport in a single storey building ? For instance a motor car factory runs the whole length of the building and is on the ground floor. What is the best form of transport from section to section in that shop ? Why is it in this country that water transport is such a disadvantage by comparison with water transport on the Continent ?

MR. MYCOE : The question of packing goods in a container depends somewhat on the material you are packing. (Mr. Mycoe described various methods, mentioning straw pads—straw with timber to keep material from bumping—and that they charge the

railway company, say, 30s. for timber and it will be returned carriage free after the contents have been taken out. This is worth while.) There are various types of containers as indicated in my paper but there is room for development. We are designing one at the works which I think will cut out a lot of additional packing; we are trying to arrange for shelves to be fitted in the containers. Replying to the point raised regarding the single storey building, Mr. Mycoe said that if it is a mass product place there is nothing like a conveyor; if it is a single storey building and you are moving the articles from one machine to another, the lifting platform truck is the best thing. You can have a stand made with racks which the elevator truck can lift on to its platform. Regarding water transport—canals—it is surprising they have not been developed. There is the Bridgewater Canal on the south side of our works owned by the Manchester Ship Canal Company, and if they would give us a cheap water rate to Liverpool we should not deliver to Manchester Docks. The privilege of using the canal before you put a boat on it or pay a barge man to take it is more than the rate per ton by rail. You would also have to load in wagons in a warehouse alongside the canal and then get a man to load them into the barge. I am surprised that the water transport has been neglected. I think myself that certain classes of traffic ought to have been catered for. The canals have not developed and I do not think there is one with a real up-to-date warehouse for dealing with traffic generally.

MR. LESLIE: It would be interesting if Mr. Mycoe would give an indication of the financial saving effected by using containers. In regard to internal transport, I should like to ask Mr. Mycoe what arrangements he finds necessary or efficacious in insuring deliveries from department to department. If one orders material privately from the greengrocer, you expect it delivered at the door, but with the train bogey the general practice is, I think, to unhitch the bogey which may contain material for more than one section and then proceed to another department. What responsibility is there on the transport section to see that it is unloaded? In the delivery sense they have not completed their jobs, and my experience is that considerable delay is caused in the delivery of material. It seems to me that the transport ought to take on more responsibility. In regard to this question of road competition, we have heard a lot to-night about the advantage accruing from the road transport competition, but, on the other side of the picture it appears to me that it is unfair competition to a large extent. The road transport, as Mr. Mycoe has shown, has not been fair—unfair rates of wages—nothing like the upkeep of the railway companies—and it leads one to wonder whether we are probably not going to drive the railways to an uneconomic rate.

MR. MYCOE in answering the question regarding the saving

effected in the use of containers said that he would not like to give a definite figure. He indicated that there was a saving of something like 33½ per cent. In one instance alone—the Hungarian job—there was £3,000 saving in packing. Regarding the question of road transport driving the railways to an uneconomic position, that has been happening all along. The railway companies have been tackling something that they have not been able to deal with satisfactorily because of the regulations which were impeding them. Road transport is going to be restricted. In another two or three years it will be restricted to such an extent that there will be difficulty in getting it. The Traffic Commissioner will be very loath to grant licences. I think that the railway companies have been going through a very trying period. Their redundant staffs have been cut down since the amalgamation. The L. M. & S. have not taken on an office boy for the last five or six years. My reply to the question raised concerning internal transport is, that an internal works transport acts in the same capacity as the railway company, and the railway company do not unload your vehicle or load it—by law they are not compelled to do so. In dealing with internal works transport, you get a department but you do not get a position where you have to deliver.

MR. LESLIE : Supposing there is not a full load for one of these small bogies and the bogey has to go a circuitous route with possibly three consignments put in one bogey, you would not expect the railway company to put one part in your yard and another part to be taken somewhere on the other side of Trafford Park.

Mr. Mycoe in his reply mentioned delivery to a transport control office, which is used as a sort of clearing house for transferring the material from one section to another.

A vote of thanks concluded the proceedings.

## THE ALLOCATION AND CONTROL OF OVERHEADS.

*Paper presented to the Institution, London Section, by  
T. G. Rose, M.I.P.E., M.I.Mech. E.*

I OUGHT, perhaps, to begin with an apology for the fact that the title of my paper does not properly describe its contents. Allocation is accepted as a term denoting the spreading of charges over other accounts, and in directing most of my attention to the problem of control—which appeared to me to be of major interest to the production engineer—I have dealt more with the question of dividing up overhead expenses into logical categories than with the manner in which those expenses are subsequently allocated to other accounts. It would have been better, therefore, if my title had been “The sub-division and control of overheads,” and I can only hope that none of you will feel that you have been enticed here to-night under false pretences.

The question of whether it is possible to establish some fundamental method of dealing with overheads is by no means the least important or interesting of the many problems that arise in connection with industrial activity. From the earliest days of cost ascertainment the term overhead expense has been taken to denote all that vague and amorphous mass of outgoings which arise in connection with the general running of the business, apart from the purchase of raw material and the payment of manufacturing wages. These expenses are by their nature elusive and somewhat difficult to control, so that there is a tendency to shirk the task of trying to control them, and a somewhat natural inclination to regard them as uncontrollable. For far too long a period in the early history of what might be called the modern manufacturing era the limelight was allowed to play upon the direct production costs, and the result of this was that the overheads of the business, coming as they do to a great extent under the control of other officials than the actual production staff, were left to carry on in the background until the development of the science of cost accountancy dragged them into the open for more detailed examination.

Quite an appreciable amount of literature on the subject already exists, but the authors—or such of them as I have been able to consult—appear to restrict their opinions more to the particular case than the general principle. This is perhaps to be expected,

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*January 5th, 1934.*



as not only the items of expenditure but also the circumstances under which they arise vary widely in different industries, and even in different concerns in the same industry. Each writer, therefore, has a tendency to treat the problem from the angle of his own vision, and the result is a great variety in the methods advocated

### **The Case for Analysis.**

But the study of the science of management has by now progressed so far in its establishment of fundamentals that there would seem to be a case for endeavouring to analyse this special problem from the point of view of what the manager ought to know if he is to manage effectively, rather than what the accountant must know in order to balance the company's books. In this manner we may be able to arrive at something simple and also flexible, as suitable—with due modification—for the small concern as for the large undertaking, built upon sound accountancy and giving the maximum of effective control.

It might perhaps be objected that the subject is one which should more properly be handled by our colleagues the Institute of Cost and Works Accountants. Yet it lies equally within the field of our interests, for to the production engineer to whom the true cost of the produced job is always a matter of vital importance, the question of overheads is often a cause of much heart-searching. His direct labour charge is a matter over which he himself has complete control. Over his direct material cost his control often varies; sometimes he has to use material provided for him, and sometimes he is in the position to specify it for himself. But in the overhead section of his cost, he is faced with certain charges which he can directly influence and others that are outside his sphere altogether. And yet as the responsible authority for the production costs of the concern he has to answer for the total cost of the job in which these charges must be included.

It is, therefore, of the utmost importance to the production engineer that he should have a clear idea of what these charges are, and how they are arrived at. Moreover, being a much harassed individual as a general rule, the statement of accounts should be made up not only in such a manner that he can grasp quickly and easily the genesis of these charges, but also in such a way that he can see immediately if any of them are becoming excessive, and so set about to reduce them.

### **The Aim of Analysis.**

In reading the literature on the subject and listening to papers and discussions it has struck me that there appears to be a certain amount of confusion as to the ultimate end at which the accountancy side of overhead analysis is aimed. As I see it, the recording of the

expenditure on items that must be included in the overhead charges can be carried out with two separate and distinct objects, which are : (a) The accurate ascertainment of the cost of the job with a view to the fixing of the correct selling price ; and (b) the recording of all the indirect expenditures which arise in the course of producing the goods sold, in order that a proper control may be obtained over these expenditures and a continuous effort be made to reduce them to their lowest figure conducive to working efficiency.

The first object is the goal of the cost accountant, and in reaching it he will have to traverse the field in which all the particulars needed to achieve the second object are to be found. The second object, therefore, provides the information for the first, but it will be appreciated that a true cost can be obtained without any proper control being exercised over the overhead charges, and similarly a close control over those overheads can be kept without a true cost of the work being obtained.

No doubt many of those holding positions as production engineers, production managers or works managers are often called upon to fix actual sales prices. But, strictly speaking, the fixing of a sales price is not properly a matter for a production engineer. It is the production engineer's duty to reduce the factory cost of a job to its lowest point compatible with a sound product, and it is for the cost accountant, I would submit, to find and apply the correct method suitable to his particular concern for the fair distribution of all charges of a general nature. Obviously both the production manager and the cost accountant have the same facts and figures from which to work, but it seems to me important that the production manager being concerned with cost should not demand a higher degree of complication from the cost accountant than will give him (the production manager) a prompt and accurate control of that cost ; nor, on the other hand, should the cost accountant, aiming at the true selling price, provide the production manager with so complex an allocation of all charges arising in the factory that the production manager finds it difficult to pick out those items which should be watched and apply his control to them. There is such a thing as not being able to see the wood for the trees.

### **Necessity for Differentiating between different categories of expense.**

Before we proceed to discuss overheads we must, therefore, first try to define certain lines of demarcation so that we can simplify our analysis of the whole.

The total cost of a job, as we all know, is made up of direct material, direct labour, and overheads ; Diagram I shows this in a simple manner. Direct material and labour are, of course, the charges for those items which can be booked directly against the

## THE ALLOCATION AND CONTROL OF OVERHEADS

production job. Into the third heading, that of overheads, fall all the remaining expenses connected with the work. Here we come upon our first line of demarcation. I am aware that certain firms

TOTAL COST AND SALES PRICE (1).

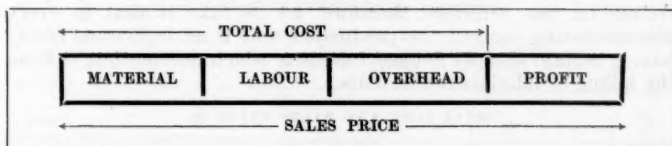


DIAGRAM I.

lump all residual charges together as overheads<sup>1</sup> and distribute them on various bases. Whilst this method has certain advantages, especially in the case of a concern where the works and head office are under one roof, I would submit that it is fundamentally wrong in principle, owing to the fact that it does not differentiate between manufacturing charges and selling and administrative charges.

The Institute of Industrial Administration in its latest syllabus splits the responsibilities of management into five main functions—production, distribution, development, accounts and finance, and legal and secretarial. This, I think, is a sound division, and where functional responsibility exists it is always sound to establish functional cost. The head of every department should know what his department is costing in relation to some basic figure arising from the activity of the concern. And if the cost of one department is to be established as distinct from the cost of another, there is a clear case for some basic splitting of overheads.

In the vast majority of cases the production side of an undertaking is definitely separated from the distribution side, and the man in charge of the former has little or no influence on the latter. Again, whilst the secretary of a company is frequently the accountant as well and, in addition, in charge of the work done in the general office, he also has little or no influence over either the production or the distribution activities. If, therefore, all the multitudinous items of expenditure arising from the sales department and the general office, to say nothing of directors' fees, interest charges, and so forth, are amalgamated with the miscellaneous indirect expenses arising on the production side, we shall obtain, when these expenses are set out, a large and complicated statement too clumsy to be of any real assistance except for research purposes, and it will certainly not be possible for the production manager to ascertain in a simple manner the particular charges that come under his control.

If any degree of real control is to be obtained, the first thing to be done is to break up the mass of statistics that arise in an industrial

undertaking into broad categories, sub-dividing these subsequently as the need may arise up to a point where control can still be kept by a weekly or monthly survey. Beyond that point it would appear to me to be useless to go, except where such circumstances arise as call for a finer sub-division for some specific management purpose. Acting on this principle, therefore, let us take it that in every manufacturing concern the production unit is an individual entity having certain sharply defined functions which differentiate it from the selling or administrative units.

TOTAL COST AND SALES PRICE (2).

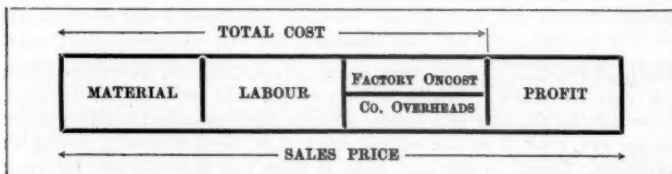


DIAGRAM II.

Our first line of demarcation then comes in separating the overheads arising from running the works from the overheads arising from running the company as a whole. We arrive, therefore, at Diagram II, in which the overhead component is split into factory oncost and company overheads. I propose throughout the remainder of this paper to use the word oncost when applied to factory expenses and overhead when applied to company expenses.

#### The Statement of Account.

Perhaps the importance of differentiating between factory oncost and company overheads will be made somewhat more clear if Diagram III is considered. This is the standard control statement of account for a manufacturing concern, working from the sales turnover through the cost of goods sold down to the profit or loss for the period; a method of presenting the results that is becoming increasingly used in control work.

Beneath the sales turnover will be seen the opening stocks. To these are added the direct material, the direct labour, and the factory oncosts for the period, and from the sum of these is deducted the closing stocks. This gives the cost of goods sold, since if you start with the cost of the opening stocks, add the cost expenditure for the period and deduct from the whole the cost of what is left in the place at the end of the period, the result must be the cost of what has gone out. Subtracting, therefore, this cost of goods sold from the sales turnover gives the factory surplus, and before we go any further I should like to spend a few moments in emphasising the importance of this figure on what may be termed management accountancy.

# THE ALLOCATION AND CONTROL OF OVERHEADS

All of us work better when we have a definite goal at which to aim, and when we know that in our efforts to attain that goal we are not going to be hampered by any external influences over which we have no control. The works manager or the production

## CONTROL STATEMENT OF ACCOUNTS.

JOHN DOE & Co. LTD.

(Month of August).

Item		£	£	£	% of
1	SALES TURNOVER ... ..			12,644	
	COST OF MANUFACTURE:				
2	Opening stocks ... ..		34,345		
3	Direct material ... ..		1,760		
4	Direct labour ... ..		2,778		
5	Factory oncost ... ..		3,362		
	Sum ... ..		42,245		
6	Deduct: Closing stocks ... ..		34,672		
7	COST OF GOODS SOLD ... ..			7,573	
8	FACTORY SURPLUS ... ..			5,071	
9	Deduct: Exceptional trading expenses...			78	
10	Representing a GROSS TRADING PROFIT ....			4,993	
	Deduct: COMPANY OVERHEADS:				
11	Selling expenses ... ..	647			
12	Company general charges ... ..	1,332			
13	Company standing charges ... ..	275			
	FIXED CHARGES:		2,254		
14	Interest on debentures ... ..	45			
15	Interest on loans ... ..	68			
			103	2,357	
16	Representing a NET TRADING PROFIT ...			2,636	
17	Add: Sundry income (not from trading) .			115	
18	Representing a PROFIT ON GOING CONCERN			2,751	
	Deduct: SPECIAL CHARGES:				
19	Sussex works (closed) ... ..		42		
20	Income-tax ... ..		85	127	
21					
22	Representing a NET DIVISIBLE PROFIT of On sales turnover for period ... ..			2,624	20.8

DIAGRAM III.

engineer who is endeavouring to bring about a reduction of cost usually, in my experience, suffers from a feeling of suspicion, sometimes amounting almost to despair, with regard to the charges that are piled upon him at the later end of his estimates. Such burdens often swamp the savings through improvements that he has been able to effect, and render his arduous work hard to perceive. There is little satisfaction, except the eternal pride in the job which fortunately is present in the minds of most production engineers, in reducing the works cost of an article if the percentages subsequently added to cover sales charges or general company overheads bring the price back to an uneconomical one. The works manager has little or nothing to do with charges such as these,

therefore the ideal to be kept in view should be to make up the accounts in such a way that as far as possible he is definitely cleared of all charges other than those arising from his own department.

### **Management Accountancy.**

At this point it may be as well to make clear that the main principle at the back of what I call management accountancy is to arrange income and expenditure in their proper sequence, so that the charges on the business are brought in step by step in their proper places as the work proceeds. It is impossible to do this by the ordinary method of using the trading account and profit and loss account, and it was the need for something better than those that brought into being the statement of account used in higher control work, an example of which I have just shown you.

If we proceed to examine the expenses arising in an industrial undertaking a little more closely, we find that there are, both in factory oncosts and company overheads, items which are constant in that they recur from month to month all the year round, though in varying amounts, and items which are exceptional and do not recur. This brings us to the next principle of control, and that is that it is sound practice to eliminate from the items which it is desired to control any exceptional entries which, if they were included, would prevent proper comparison month by month. These exceptional expenses will be found to occur in both the factory oncosts and the company overheads. For instance, a fire or a flood may occur in the factory, which causes a considerable amount of damage; it would not be fair to the works manager to charge the cost of the repairs to his standard factory oncosts. Again, the company may lose a law suit and have to pay damages, or perhaps a sum will be spent in pensioning an old member of the staff. A place has to be found somewhere in the company's accounts for such expenditure, and in the ordinary accountancy method such expenses would be included in the company overheads. But this is just as contrary to the management outlook as classing flood damage as an ordinary factory oncost. If the sum incurred in damages or compensation be included in the company overheads, the comparison with other months or years will be vitiated and the management picture distorted. For these charges, therefore, it is as well to create a special category of exceptional trading expenses, so that the factory oncosts and the company overheads can be kept clear of any disturbing influence.

Considering the statement of accounts a little further, it will be seen that after the exceptional trading expenses have been deducted from the factory surplus we obtain the gross trading profit. Next fall to be deducted the company overheads, in which a division is made in such a manner that the overheads necessary to sell the



goods are clearly discernable and separated from the general and standing charges relating to the running of the concern. The fixed charges, which come next, refer to debenture or loan interest—in other words they represent the cost of borrowed money, and at this point of the proceedings we arrive at the net profit from the trading of the concern. The sundry income is then added in, it being important to keep this separate from the trading results, and so we obtain the profit on the going concern.

A good many undertakings have burdens that they are forced to bear in the shape of closed factories, empty offices or shops, useless plant, and so forth, which were at one time of active value to the business, but are now derelict owing to change of policy or other reasons. The charges still accruing from these must be met, but they form no part of the cost of the going concern at the moment. These are, therefore, termed "special charges" and deducted at the end of the statement, so that the true final position can be obtained.

We have now five separate categories of expenditure into which the different overhead items can be brought :

- (1) Factory oncosts.
- (2) Exceptional trading expenses.
- (3) Company overheads.
- (4) Fixed charges.
- (5) Special charges.

As far as this paper is concerned we shall deal only with the first item, factory oncosts, and once again we must study the position, so as to see what sub-divisions can be made of the great mass of items involved. Without some main categories to help us we shall find it impossible to apply that practical control which is our main objective.

### **Expense Sub-division.**

From the literature available on the subject it is apparent that opinions differ as to how this question of sub-division should be approached. Some authors recommend sub-divisions based upon authority in the organisation; others divide them into fixed, producing, and commercial expenses. A third method splits them into constant and variable expenditure, and there are some writers who do not attempt any main categorical sub-divisions, but go straight to the departmental headings.

This widely-varying opinion is very confusing to the layman, and appears to be due to the fact that accountancy allows the choice of several paths by which to approach the same result. In fact, after studying some 30 extracts from costing and management books and papers, one is tempted to quote the well-known Kipling

# THE INSTITUTION OF PRODUCTION ENGINEERS

## TRADING ACCOUNT.

FOR THE MONTH ENDING 31ST AUGUST.

	£		£
To Stocks at 1st August ...	34,345	By Sales ...	12,644
" Purchases ...	1,760	" Stocks at 31st August ...	34,672
" Wages and salaries ...	4,226		
" Coal and coke ...	259		
" Stationery ...	19		
" Electricity ...	90		
" Gas ...	9		
" Water ...	15		
" Petrol ...	15		
" Packing cases, etc. ...	44		
" Wipers and waste ...	12		
" Timber ...	25		
" Drawing office supplies ...	17		
" National Insurance ...	88		
" Miscellaneous supplies ...	139		
" Employers' liability ...	18		
" Repairs and renewals ...	420		
" Rent, rates, and taxes ...	60		
" Patent fees ...	17		
" Travelling expenses ...	43		
" Postage and telephones ...	10		
" Insurance ...	55		
" Depreciation ...	368		
" Loose tools, etc. ...	115		
" Maintenance ...	76		
" Gross profit ...	5,071		
	<u>£47,316</u>		<u>£47,316</u>

DIAGRAM IV.

verse : " There are nine and sixty ways of constructing tribal lays, and every single one of them is right." Right they certainly are up to a point ; but in many cases that point seems far from efficiency when management value is in question.

Since all matters relating to the income and expenditure of a concern must be recorded in the company's books of account, the soundest way of endeavouring to see clearly through the problem

## ELEMENTARY COST STATEMENT.

	£	£	% of
<b>PRIME COST :</b>			
Direct material ...	1,760		
Direct labour ...	2,778		
<b>TOTAL PRIME COST</b> ...		4,538	
<b>FACTORY ONCOST :</b>			
Indirect material ...	835		
Indirect labour ...	937		
Miscellaneous expenses ...	1,590		
<b>TOTAL FACTORY ONCOST</b> ...		3,362	
<b>TOTAL FACTORY COST</b> ...		7,900	

DIAGRAM V.

# THE ALLOCATION AND CONTROL OF OVERHEADS

may be to start from the very beginning. Let us take, therefore, the ordinary accountancy statement known as the trading account. Diagram IV represents a typical example of a trading account.

## WORKING COST ANALYSIS.

MONTH OF AUGUST.

	£	£	£	% of
<b>PRIME COST :</b>				
<i>Direct material :</i>				
(1) Castings ... ..	375			
(2) Forgings ... ..	863			
(3) Bar ... ..	311			
(4) Miscellaneous ... ..	211			
		1,760		
<i>Direct labour :</i>				
(1) Skilled (60.6 per cent.) ... ..	1,685			
(2) Semi-skilled (30.1 per cent.) ... ..	835			
(3) Apprentices (9.3 per cent.) ... ..	258			
		2,778		
<b>TOTAL PRIME COST</b> ... ..			4,538	
<b>FACTORY ONCOST :</b>				
<i>Indirect material :</i>				
(1) Electricity ... ..	90			
(2) Gas ... ..	9			
(3) Toolroom, millwrights, and electricians ... ..	191			
(4) Shop supplies ... ..	123			
(5) Timber ... ..	25			
(6) Packing cases, etc. ... ..	44			
(7) Coal and coke ... ..	250			
(8) Petrol ... ..	15			
(9) Stationery and drawing office materials ... ..	36			
(10) Miscellaneous ... ..	43			
		835		
<i>Indirect labour :</i>				
(1) Supervision ... ..	238			
(2) Inspection ... ..	87			
(3) Drawing office ... ..	48			
(4) Pattern shop ... ..	52			
(5) Toolroom ... ..	131			
(6) Stores ... ..	24			
(7) Millwrights and electricians ... ..	49			
(8) Yard and general ... ..	117			
(9) Packing and dispatch ... ..	46			
(10) Works clerks, and progress ... ..	52			
(11) Time office and watch ... ..	25			
(12) Power house ... ..	44			
(13) Garage ... ..	24			
		937		
<i>Miscellaneous Expenses :</i>				
(a) <i>General charges :</i>				
(1) Management salaries ... ..	491			
(2) National Insurance ... ..	88			
(3) Overtime and night rate ... ..	20			
(4) Employers' liability ... ..	18			
(5) Repairs and renewals ... ..	420			
(6) Travelling expenses ... ..	43			
(7) Patent fees ... ..	17			
(8) Postage and telephones ... ..	10			
		1,107		
(b) <i>Standing charges :</i>				
(1) Rent, rates, and taxes ... ..	60			
(2) Insurance ... ..	55			
(3) Depreciation ... ..	368			
		483		
<b>TOTAL FACTORY ONCOST</b> ... ..			3,362	
<b>TOTAL FACTORY COST</b> ... ..			7,900	

DIAGRAM VI.

## THE INSTITUTION OF PRODUCTION ENGINEERS

It consists of a miscellaneous collection of items, and no attempt is usually made to keep them in any sequence of a logical nature. I do not think it is an exaggeration to say that 50 per cent. of the accounts of industrial undertakings to-day are prepared more or less in this manner. This, then, is the raw material on which we start working, and we begin by differentiating between prime cost (direct material and direct labour) and factory oncost. In this manner we obtain Diagram V, our first step in the direction of control. Already from this, we can get a check on the percentage of indirect against direct labour, and review each month the lump sum spent on indirect material.

In Diagram VI we see the previous stage developed into a very useful statement. Certain prime cost figures are given for management control purposes, and in the factory oncost section the miscellaneous expenses group has been split up into general charges and standing charges, and itemised. This statement, with suitable minor modifications depending upon the industry or type of concern involved, permits a very considerable degree of control. In fact, in those branches of industry where the machine hour rate is not applicable—such as, for instance, coal—Diagram VI can be used for obtaining a reasonably accurate cost figure, where the production can be measured in some physical unit.

### Productive and Service Departments.

In the next step forward, Diagram VII, we introduce a new point of view. The productive work carried on in a factory cannot

#### ALLOCATION OF INDIRECT MATERIAL AND LABOUR TO PRODUCTION AND SERVICE DEPARTMENTS.

	£	£	£	£
<b>PRIME COST :</b>				
Direct material ... ..			1,760	
Direct labour ... ..			2,778	
<b>TOTAL PRIME COST</b> ... ..				4,538
<b>FACTORY ONCOST :</b>				
<i>Indirect material :</i>				
(a) Used in production departments ... ..		157		
(b) Used in service departments ... ..		678		
			835	
<i>Indirect labour :</i>				
(a) Employed in production departments :				
Supervision ... ..		124		
(b) Employed in service departments :				
Supervision ... ..	114			
General ... ..	699			
		813		
<b>GENERAL CHARGES</b> ... ..			937	
<b>STANDING CHARGES</b> ... ..			1,107	
			483	
<b>TOTAL FACTORY ONCOST</b> ... ..				3,362
<b>TOTAL FACTORY COST</b> ... ..				7,900

DIAGRAM VII.

function without the assistance of a considerable number of auxiliary departments or sections. A works, in fact, consists of a certain number of departments engaged in production, charging labour and material directly to the work, and a certain number of service departments engaged in assisting the producing departments. The oncosts of the business, therefore, are to be found in the service departments, but not entirely, since we cannot avoid using in the producing departments certain items of indirect material, such as cutting compound, oil, wipers, and such like. Much of the supervision, also, will be used in the production shops, and for the purpose of control it becomes necessary to establish :

- (a) The proportion of oncost used in the productive departments.
- (b) The proportion of oncost used in the service departments.

Diagram VII re-arranges the items of indirect material and labour in this manner, and the items of general charges and standing charges have been taken once more as lump sums, and not itemised. This has been done intentionally, and for the following reasons :

The amount of time available to the average production manager or works manager for dealing with oncost problems is usually small. His duties are manifold and amongst all his daily worries over his production position the items that go to make up the oncost charges usually come in for scant attention. It is, therefore, most necessary that it should be made as easy as possible for him to see what is going on, and to do this we must, wherever possible, avoid asking him to worry about items over which he can have no real control.

You will remember that in Diagram VI we divided the oncost items into indirect labour, indirect material, standing charges and general charges. Now the last two of these are essentially made up of items over which the manager has little influence. They may vary month by month to some small extent. National insurance, for instance, will rise or fall with the total number of men employed, but it is beyond the powers of the manager to reduce the amount payable.

### Primary Oncosts.

We come, therefore, to a point which, in my opinion, is of some importance in the control of oncosts, and that is that the main items which the manager should be called upon to watch are those relating to indirect material and labour. Further, if we are dealing purely with the control of oncosts, we are not called upon to allocate the charges of the service departments to the productive departments. All we want to know is the proportion of indirect labour and material that are used in the production departments and the proportion of indirect labour and material that are used in the

# THE INSTITUTION OF PRODUCTION ENGINEERS

service departments, so that we may make the total figure for these items shown in the manager's schedule tally with the figures in the company's books. With this end in view we obtain Diagram VIII, which is in itself of little value, except as a transition stage to Diagram IX.

## TRANSITION STAGE—FACTORY ONCOST ANALYSIS.

	Indirect material	INDIRECT LABOUR		TOTAL
		Super'n	General	
	£	£	£	£
FACTORY ONCOST:				
Used in production departments ... ..	157	124	—	281
Used in service departments ... ..	678	114	609	1,491
TOTAL ... ..	835	238	609	1,772
		Total general charges ...		1,107
		Total standing charges ...		483
		TOTAL FACTORY ONCOST ...		£3,382

DIAGRAM VIII.

Where it is not desired or possible to proceed to the allocation of all oncost expenditure to the producing departments and so arrive at the machine hour rate method of costing, Diagram IX represents a suggested method of obtaining effective oncost control.

It will be seen that vertically the schedule is split into the different producing and service departments. Horizontally the charges for indirect material and indirect labour against each department are shown, and in this manner the manager is able to see the total indirect cost of any department, and, at the same time, how that total cost has been made up. From the vertical columns he can control the total expenditures on various items of indirect material and indirect labour, and if these figures are taken out monthly and entered on simple line charts on which some predetermined normal lines have been drawn, it should enable the manager to effect as practical a control of what is going on as lies within the bounds of reasonable possibility.

## Importance of "Normals."

It should not be forgotten that the mere extraction of the figures is of little assistance if some standard or normal is not set, so that the actual result can be compared with the standard. This setting of normals is not an easy task, since the activity of a service department may bear little relation to the simultaneous activity of the production departments, or of the turnover as a whole. But some percentage or lump sum should be set for limiting the main categories of expense, so that the manager, in studying his results, can see whether they are higher or lower than they should be.

# THE ALLOCATION AND CONTROL OF OVERHEADS

I would like to emphasise at this point that the departments shown on these schedules and the expenditure figures set against them have been made up purely for demonstration purposes. In a large works the service departments can be split up into 20 or

## FACTORY ONCOST CONTROL STATEMENT.

	Indirect material						Indirect labour.		Total cost of department.	% of.
	S.D.D. material.	Electricity.	Gas (heating).	Shop supplies.	Stationery.	Miscellaneous.	Supervision	Labour.		
	£	£	£	£	£	£	£	£	£	
<b>PRODUCTION DEPARTMENTS :</b>										
Turning... ..	—	17	—	12	—	—	22	—	51	
Milling ... ..	—	12	—	22	—	—	20	—	64	
Drilling ... ..	—	8	—	21	—	—	20	—	49	
Grinding ... ..	—	14	—	18	—	—	18	—	50	
Fitting ... ..	—	—	—	12	—	1	20	—	33	
Assembly ... ..	—	—	—	8	—	2	24	—	34	
<b>TOTAL production departments</b>	—	51	—	103	—	3	124	—	281	
<b>SERVICE DEPARTMENTS :</b>										
Drawing office... ..	17	3	2	—	—	1	—	48	71	
Pattern shop ... ..	33	2	—	2	—	1	22	52	112	
Toolroom ... ..	115	2	—	7	4	—	30	181	289	
Inspection ... ..	—	1	—	1	—	1	22	87	112	
Stores ... ..	—	4	2	1	2	—	—	24	33	
Millwrights and electricians ...	76	8	—	—	—	—	5	49	140	
Yard and general labour ...	12	—	—	2	—	—	5	117	136	
Packing and dispatch ...	44	—	1	1	—	—	5	46	97	
Works clerks, and progress ...	—	—	3	1	11	2	20	52	89	
Time office and watch ...	—	—	1	—	2	—	—	25	28	
Power house ... ..	274	18	—	2	—	—	5	44	343	
Garage ... ..	15	1	—	1	—	—	—	24	41	
<b>TOTAL service departments</b>	586	39	9	20	19	5	114	699	1,491	
<b>TOTAL production and service</b>	586	90	9	123	19	8	238	699	1,772	
<b>TOTAL GENERAL CHARGES</b> ... ..	...	...	...	...	...	...	...	...	1,107	
<b>TOTAL STANDING CHARGES</b> ... ..	...	...	...	...	...	...	...	...	483	
<b>TOTAL FACTORY ONCOST FOR MONTH</b> ...	...	...	...	...	...	...	...	...	23,362	
<b>Ratio to direct labour</b> ... ..	...	...	...	...	...	...	...	per cent.	121	

DIAGRAM IX

30 items and the production departments into almost as many more. Indirect material can be sub-divided almost indefinitely, but my own experience is that if too much detail is brought into these schedules, the only result is confusion to the eye and a feeling on the part of the manager that he has not got time to go into it all properly. It is far better to restrict both the departments and the items of expenditure to the fewest possible main divisions, and when



one of these main divisions or items rises above the normal that has been set, it is an easy matter for the manager to inquire for details of that particular item, and so put his finger on what is going wrong. After all, as production engineers we are very fully aware of the remorseless rush of happenings in a works. There is no time to do more than try to bag a few birds as the covey comes over each day, but it is better to bag a few than it is to be so anxious to bag the lot that one has not time to shoot at all. I feel somewhat strongly on this point, because in my own personal work as a production manager and a works manager I used to be obsessed by the impossibility of ever properly carrying out the duties for which I was responsible, and I therefore endeavoured to reduce those duties to broad subdivisions and furnish myself with some form of statistical return from each by which I could see whether matters were going better or worse each month. I found that I never had enough time available to go properly into everything, and that if I tried to do so, the weeks passed so quickly that the new month's figures were upon me before the old ones had been properly discussed. It seemed to me that the only hope for practical control was to reduce the items that had to be surveyed to the smallest possible number, and it is for this reason that I would earnestly recommend those of you who are considering the points put forward to-night not to spread out the individual items on schedule IX to the maximum that you would like to see, but to restrict them to those which you must see.

### Schedule Make-up.

In schedules of this type personal opinion naturally has a good deal to do with the final make-up, and I wish to make it as clear as I can that my own illustration given here can—and in fact should—be varied in accordance with individual requirements. You will notice, for instance, in the first column of the indirect material section the heading "S.D.D. Material." This stands for service department direct material, and refers to the material used in each service department in its specific service work. The pattern shop, for instance, will use timber, glue, screws, and so forth; the power department will use coal and water. If all these items are set out under their different categories, we should need an impossible number of columns. I would suggest, therefore, that the manager should decide with the cost accountant exactly what represents the direct material used in every service department, and as the figures come through he will know how he stands. But the material record could equally be shown under different physical headings, and charged to the departments using it.

There is another point which might perhaps call for explanation. It will be noted that I have allocated no indirect labour to the production departments, but shown this as one figure under "yard

and general labouring " in the service departments. This, again, is a matter for individual opinion. I do not claim that it is necessarily sound practice, but it is possible to have one foreman or charge hand labourer allocating the general shop labouring to the different departments, making a daily round to ascertain that every foreman is satisfied. If preferred, however, there is no reason why the general labouring in the production shops should not be shown in that column and the yard labourers would then be shown by themselves under that heading.

### Control of Services.

There is a further point in connection with the efficient control of oncosts which I should like to bring forward here. It has been my experience as a works manager that the service departments in their desire to be efficient and helpful to the productive departments will always hasten to provide anything which they are called upon to make or do. A requisition is often a good enough authority for the expenditure of quite large sums, and the service foremen, anxious that there shall be no complaint that they are hindering the work, will often run the firm into quite unnecessary expenditure. In a large concern this unnecessary expenditure must run to thousands of pounds per annum, and the checking of this expenditure is by no means an easy task.

Personally I believe that on the whole service expenditure is best kept in hand by restraining the giver rather than the receiver—by holding up the service departments against a maximum expenditure per month, rather than by endeavouring to limit in some way the demands made upon that service department. There are very few concerns in which the service work varies largely month by month, and the cost of such service work should obviously bear some relation to the works' output. That being so, there should belittle difficulty in budgeting for a monthly expenditure for each service department, and the figure could be varied according to the manager's knowledge of the position.

It may be objected that the tool room foreman, for instance, has no control over the requisitions sent to him for tools; he is there to provide the necessary tools and fixtures, and it is not his business to question what he is instructed to do. There may be here to-night a few of those advanced managers who plan every step of their production, and whose service departments work to programme in precisely the same way as their production departments. Unfortunately, such firms are still few and far between, and the vast majority of works to-day in this country restrict their planning, such as it is, to the production departments, and leave the service departments to supply their services on demand. What I am trying to do here is to put forward a method which is not only

simple as far as the accountancy goes, but which gives some definite form of control to those who are responsible for the running costs of the works. And I do not think that the suggestion that the service departments should be restricted in their services is really as unpractical as it might appear at first sight. It may form, at any rate, a good subject for discussion later.

### **Responsibility for Expenditure.**

It is of the greatest importance that those who bring about the expenditure of the firm's money through indirect channels should be made to realise that they are as much responsible for the final profit or loss of the undertaking as those who are more in the limelight, manning the direct productive machinery. The manager who is in close touch with his shops will know well enough whether a service foreman, in trying to economise, is causing a drag on the production work, and it is definitely a salutary thing for it to be known about the place that it is not always possible to get everything one wants, or thinks one wants, merely by issuing a requisition.

I am well aware that such requisitions are always brought to the manager for signature. I do not think, however, that any practical man would consider this an adequate form of control, as we all know what it means to have a pile of requisitions set before us, and how much time it is possible to give to investigating whether each individual requisition is justified or not. If control is to be obtained to any practical extent, that control must aim at making the head of each service department responsible for the expense of his department and the efficiency of his service to those requiring it. Only by delegating responsibility in this direction can any degree of control be properly obtained, and even if that control is by no means perfect, it is a great deal better than none at all.

It may be well to point out that Diagram IX does not profess to give any information regarding costs. It is built up purely with the object of ascertaining where the money expended in indirect material and labour has gone—which is, after all, what the manager wants to know. I wish, however, to make this clear, because I do not want our friends and colleagues, the cost accountants, to criticise the schedule from their specialised point of view. Their work, which has the same definite constructive value on the accounting side as ours has on the technical production side, aims at giving us accurate costs and so arriving at accurate sale prices.

It is, I think, agreed nowadays that the only really satisfactory method of ascertaining the true cost of any article is to work it on the machine hour rate principle. To arrive at this we must take Diagram IX and develop it a stage further, so as to charge the expenses of the service departments, the general charges and the standing charges across the production departments, and so arrive

# THE ALLOCATION AND CONTROL OF OVERHEADS

## ALLOCATION OF FACTORY ONCOSTS TO PRODUCTION DEPARTMENTS FOR COSTING PURPOSES.

Production Depts.	Individual Costs	Allocated Costs.											Standing charges.	General Charges.	Total.
		Drawing office.	Pattern shop.	Toolroom.	Inspection.	Stores.	Millwrights and electricians.	Yard and general labour.	Packing and dispatch.	Works clerks, and progress.	Time office and watch.	Power house.	Garage.		
Turning	51	12	89	48	13	5	26	32	16	15	7	76	7	185	607
Milling	64	11	10	63	14	4	20	22	16	15	9	74	7	197	616
Drilling	50	12	13	53	12	3	27	20	16	15	6	70	7	203	608
Grinding	56	12	13	53	12	3	27	20	16	15	6	70	7	203	608
Fitting	33	12	—	40	25	11	12	19	16	15	6	70	7	185	611
Assembly	34	11	—	29	30	8	20	13	17	14	12	51	6	146	473
TOTAL	281	71	112	289	112	33	140	136	97	89	28	343	41	1,107	3,362

DIAGRAM X.

at the cost of an hour's work in each of these. I do not propose to spend time to-night in dealing with the bases of this allocation. The principles have been dealt with exhaustively in a number of books and papers by expert cost accountants, and those who are interested in the matter can study the details at their leisure. When this is done we should obtain something after the nature of Diagram X, and from this schedule the machine hour rate in each productive department can be built up and the true cost of individual jobs be thereby obtained. This is, however, a costing matter, and not a control matter, and therefore it appears to me that the objective of control can best be served by Diagram IX.

I would remind you that I have spoken to-night almost entirely on factory expenses and their control. To obtain the cost to sell a job it is necessary to take into the calculations the residual charges, the remaining four of the five categories of expense that I mentioned previously. The method of working this, again, is dealt with in the text books on cost accountancy. It is usually done by building up a series of percentage additions to the cost of manufacture after this has been ascertained.

In the make-up of schedules such as those set out here, a number of queries and doubtful cases invariably arise, and in such matters it is best to rely upon the commonsense and the experience of the cost accountant. What we are endeavouring to do here is not to formulate a scheme for a cost accounting system, but to suggest a method of presenting the cost summaries and analyses which will make it easier for the manager to do his job. In taking the subject as we have done to-night from the simplest statement onwards we are, I think, going a better way about the work than by starting with the ideal and working backwards. It should never be forgotten that the large firm with a big costing department, and perhaps mechanical accounting machinery installed, is very much the exception in this country as everywhere else.

### **The Small Undertaking.**

Not long ago, Mr. Robert Hyde, in a letter to *The Times* pointed out that there were 127,768 places registered under the Factory Act. Of these 421 employed 1,000 and upwards, 949 employed from 501 to 1,000, 9,251 employed between 100 and 500, and the remainder, 117,147, employed less than 100 workpeople. Admittedly the greater proportion of this immense last category may be little places of an insignificant type, but the figures certainly show that the small place is the backbone of our national industry. For this reason I think that in our work and in our aims we ought to do our utmost to smooth the path of the small concern, simplifying and adapting those methods which have been proved successful

## THE ALLOCATION AND CONTROL OF OVERHEADS

by the larger undertakings, so that the small firm can, to the utmost of its capacity, go and do likewise.

Throughout this paper I have frequently spoken of "departments" but a "department" may consist of a single individual, or even the part time of a single individual. It is the functional division of work that is implied, and these divisions of work exist in a small place just as in a large one. The number of persons employed in carrying out the duties arising from a certain functional division is immaterial.

All concerns, whether large or small, possess their factory oncost and company overhead expenses. If, therefore, we, as production engineers, can suggest some simple system, not of keeping accounts which is not our business, but of getting those accounts arranged in such a manner that they help us to manage more effectively and efficiently, we shall have taken one more step towards a satisfactory method of dealing with those insidious overheads that so often cripple our best endeavours on the technical side.

## Discussion.

MR. HAWKINS : We have listened to a very interesting paper by Mr. Rose, from which it is easy to see that he is an old campaigner. Like every good General he has covered up his vulnerable points, even if he has only used a thin screen at times. Without being too critical I think that from an engineer's point of view Mr. Rose has dealt with the whole subject too much from the point of "What has happened can't be helped ; let's try and do better in the future"—in other words, locking the stable door after the horse is out. To my mind the whole question of factory oncosts or factory overheads from the production manager's point of view should be controlled before the expenditure is made and not afterwards. This may sound a little revolutionary, but Mr. Rose has already touched upon it to a certain extent. It is just as easy to plan the number of labourers you require and the amount of tools you require to do a job, the units of electricity or tons of coal to run your machines a certain number of hours, as it is to plan the sequence of operations and fix the time rates or piece work times, or even calculate the material you want.

In a factory, the production in which is reasonably stable, certain expenses bear more or less the same relationship to one another from one year to the next to a degree which is remarkable, allowances of course being made for known fluctuations, such as tax on fuel oil, increase in National Insurance contributions, etc., and it is this relationship of the various headings of expenditure to one another which enables one to formulate a system of controlling expenditure before it is spent. To give an instance, in a certain factory over a period of several years it was found that the cost of miscellaneous small tools, i.e., cutters, broaches, drills, files, etc., averaged out at a definite relation to and varying with production variations. From these figures a curve was struck and now it is only necessary for the production manager to say, "We are going to produce a given volume of production during a given time" for the tool room superintendent to know the permissible expenditure on small tools during the same period, and within the limits of this permissible expenditure he is allowed to use his discretion. He is, however, responsible for seeing that there are no hold-ups in the production, any such hold-ups being immediately reported to the works manager. As a side light on this scheme it is interesting to note that over a period of some three to four years, I do not think there have been more than possibly a couple of pounds worth of time charged up against the tool room due to breakdowns in the production occasioned by shortage of suitable tools. As I have said, I think Mr. Rose has pretty well covered the point of view of what you do and how to



record the information after you have got it. That is why I thought I would open the discussion from the point of view of "Why not know what you are going to spend before you spend it?" I should like to congratulate Mr. Rose on the able way in which he has given his paper, and trust he will accept my remarks in the spirit in which they are meant, with the object of opening up the general discussion on the paper.

MR. ROSE : Mr. Hawkins accuses me of having taken the wind out of his sails by anticipating criticism, but that is a precautionary measure adopted by most people who write papers. I am entirely in agreement with him when he says that expenditure should be controlled beforehand. But you have first got to get your schedule of expenses drawn up and watch the figures coming in for a few months. Then you can begin to set normals to be worked to.

The principal reason, I think, why people of goodwill in the matter do not look ahead more and plan their overhead expenditure is because they have not time. In the bigger firms much can be done, but it is difficult when you come down to the small firm employing 50 men, staff, and operatives. When you get into a little concern the sums involved are so small that a very small increase in the expenditure makes a large percentage increase in the total. Often what the larger firm can do effectively, the smaller firm does find very difficult indeed to bring about.

I agree that it is not always easy to decide the definite comparative basis that I urged you to try to find. But from what Mr. Hawkins said with regard to the expenditure on small tools in the works he used as an example it is clear that practical relations can be found.

MR. MOSEY : I would like to raise some points regarding the relation between direct labour and overheads. In a great many factories what is termed unproductive labour or more properly indirect labour tends to be pushed in with the overheads whereas the functions which relate it to the direct labour and thus to the direct cost can often be determined.

Our firm have recently done a great deal of work in sorting and relating the indirect labour charges and the strictly productional labour charges. In this form they represent in many cases a large proportion of the total overheads. The tendency to increasing indirect charges is noticeable in many small specialised industries as well as the larger industries. Perhaps it might be said "the greater the degree of specialisation the higher the indirect labour and plant charges." Thus the correct allocation of these indirect labour charges becomes so important in the cases to which I refer that I wondered how far Mr. Rose could help us in offering suggestions for handling them independently.

MR. ROSE : I gather what you mean is that in your case the direct labour is a very small percentage of the total cost. Con-

sequently if you want to make up a cost and you want to recover overheads by means of a percentage on your direct labour, you will find it requires to come up to a very high percentage to do so.

There is a tendency for labour which is definitely part of the production, but which cannot easily be booked to individual articles, to be treated as indirect. It is important to see that all labour, whether skilled or unskilled, should be charged directly to the job if that can possibly be done. If even under these circumstances the proportion of direct labour in the total cost is small, then you will be forced to adopt some other method of basing the recovery of your overheads—preferably the machine-hour rate method. Prime cost is sometimes taken, but should only be used where the proportion of direct material remains constant in the different jobs. It is usually an unsatisfactory method of working.

MR. EMERY: There are certain overhead charges which are directly in relation to material costs, buying charges, storekeeping, and labour in material handling, and it seems to me that the combined recovery of overhead expense by a percentage on material, to recover your storekeeping and handling charges and buying charges, plus a percentage on your production wage recovered, would probably be the most scientific way to balance them up.

MR. ROSE: It might be possible to split your overheads into those affected by material, and those affected by labour, and so apply a different percentage to each; but it might lead to difficulties.

MR. FRANCIS: Can Mr. Rose say how any individual manager is able to see that his own factory oncosts in relation to his direct labour bear a reasonable proportion? In various firms in the same industry the proportion of overhead expense to direct expense does vary enormously. In two factories producing the same article you may get a percentage of 100 per cent. indirect to direct labour in one factory, and 50 per cent. in a precisely similar factory producing the same article. The manager who has 100 per cent. overheads is only able to see his own business. How is he able to decide that his overheads are reasonable in relation to the conditions under which he is working?

MR. ROSE: I hope that as time goes on, and we get down to percentages rather than figures in these management matters, more information will become available. I am collecting them slowly myself and they are extraordinarily interesting. Conditions vary so much, however, as Mr. Francis says, that before a true comparison can be obtained it is necessary to know a good deal about the particular circumstances of the case.

It is not infrequent to find too small a selling overhead with a fairly small concern, and I am under the impression that the office side is often understaffed. That is one of the advantages of the control method, since when you sort the figures out into the proper

categories you can see clearly how much is being spent in each section.

MR. PARKER : I have been responsible for organising a good many discussions between executives in various businesses for comparing their figures, management ratios, and what not, but I content myself with saying that there is a danger of such discussions becoming a defence of one's own methods rather than an attempt to explore where the other man's method may indicate some other way of approach. I should like to follow up that question of limiting service charges—the bugbear of all works managers, and one about which one finds it extraordinarily difficult to say anything constructive. I got ready to attack Mr. Rose for suggesting, in view of his experience and his work, that a turnover curve was an adequate curve against which to check your service charges. I hope I misunderstood him. I should attack it because, as an example, when you are running through a new product your toolroom is invariably swamped ; your charges on that side are going “ hell for leather,” but you have not started to produce much less to sell, so that a simple turnover curve is, I suggest, useless as a check on that particular service charge.

I also suggest that the answer to the cost and works accountants inquiry is definitely that a trend curve is necessary. A good way to relate service expenses to some base line is to use a moving annual total curve. It does not matter whether it is cash or quantity so long as it gives you a reliable base curve, and by taking the trend or moving annual total you do iron out these seasonal fluctuations, fluctuations due to the production of new products and so on, and I suggest that it is a satisfactory base curve of great help in an attempt to control charges. The difficulty about trend curves is that while they iron out fluctuations, they necessarily compress variations, and practise alone will give easy interpretation. After all any control method is but a tool that requires skilled use.

The selection of a suitable base curve is a matter for individual selection in each case, depending on what figures are available, but the problem with which we here should be concerned is how to select some sort of a base curve, and I suggest that it cannot be a curve of current figures, but must be a trend, and that we should study. Some future meeting might well be devoted to studying how to get at a trend curve and what sort of basis to use, not only for service charges but for every other overhead. I should like to express congratulation to Mr. Rose for a very excellent paper.

MR. ROSE : Perhaps I might explain to those of you who do not know him, that Mr. Parker has a very unusual experience, because for some years he was the organising director of the Management Research Groups. In doing that he occupied the position of guide, philosopher, and friend in management matters to a large number of firms all over the country.

I am entirely in agreement with Mr. Parker's suggestion that trend curves should be used for comparative purposes. But there is one additional difficulty about these trend curves, and that is that you must have a dozen results before you can begin to plot them. It is by no means always that you can obtain those results from existing back records, and therefore delay may be caused.

Mr. TOOTHILL : I wish to have a word about the moving annual total chart. The last speaker has said that it is an excellent thing, but I suggest that it cannot be used to control shop oncost because the tendency in most businesses is for the oncost to rise and for the direct labour to decrease. This would mean that a moving annual total curve of shop oncost would be in the form of a rising line and one could not tell whether that increase was justified or not. It may be that an increase in oncost of one shop would mean a decrease in cost of materials or the direct labour in another shop so that the only real use of a moving annual total chart would be to show the direct labour and materials and the indirect expense of the entire organisation plotted against the value of sales.

In the factory with which I am concerned we commenced the control of oncost by taking the total and breaking it down. We did that weekly and produced an oncost book with the items down one side and in columnar form so each figure could be put against that of the previous week. This book goes down to the shop manager each week so that he can see whether any item has increased. The next step was to produce a sales budget and I suggest that if this is done, every item of shop oncost can be budgeted. This is also entered in the shop oncost book as a standard for comparison ; further it is split into constant and variable expense. The variable expense budget is adjusted according to the activity of the shop each week. These figures then show weekly for each item the actual oncost against the budget and the total variable expense against the activity budget and so form an efficient control.

Mr. Rose does not, in his factory oncost control statement make any allowance for a comparative statement. I should like to know whether he had this in mind or not.

Mr. ROSE : I rather hesitate about making these schedules too complicated, but a variety of works figures could be added to diagram No. 9. As far as comparison goes, it will be seen that each statement has a column for comparison on one percentage basis.

Mr. HALES : I have listened to our lecture and discussion this evening and I realise that allocation of overheads is a very wide subject. At the same time, I would suggest that we almost strain to the extreme edges of relevance in dealing with it. I am of the opinion that the members of the Institution of Production Engineers voted for a paper to be read on this subject with the object of obtaining authoritative information on overhead figures which often comprise

a large percentage of the production costs of manufacture in departments under the production engineer's control. Mr. Rose in his early remarks contends that there would seem to be a case for endeavouring to analyse this problem from the point of view of what the manager ought to know if he is to manage effectively rather than what the accountant must know in order to balance the company's books. I heartily support this point of view. The production engineer is not directly concerned with the system of recording expenditure, but I submit that he should have direct access to analysis figures of overhead expenditure which is included in the production costs of his department. A study of overhead analysis figures against individual manufacturing operations might often indicate where saving could be effected by concentration on the high spots of expense with better results than blindly striving to save minutes on operating time.

Mr. Rose in his remarks appears to have been very sorry for the small factory. In my experience the manager of a small firm often knows more about the intimate details and analysis of overheads than is the case in a larger firm where there are watertight compartments, and it is difficult for the shop production man to get figures which would help him to get better results. That is not a rule, but I am afraid it happens very often.

No doubt we have men present whose firms do for various reasons purchase from outside sources certain components used in their manufactured product—such as in the case of rush of orders beyond the capacity of the machine shop. It may be found that outside firms will quote prices lower than the works production costs, and at a later date when orders have slackened off the works have to consider machining their own components again, and then the production man concerned will have to get down to the level of or below the cost of making outside. It is a difficult job. He may check up his process, he may even go to the extent of checking up the process of the little firm who has manufactured outside, and find that his own process may be twice as quick as the little man who has quoted outside, but if he will look further he will find that the little man has overheads of  $x$ -times lower than the bigger firm, and for that reason alone he can quote cheaper. I think the little man has been scoring during the past four or five years. We know of many little firms with 50 to 100 hands who have been running a day and night shift during the times of slackness and making good profits—that in spite of the disadvantage of not having expert cost accountants to help them.

I think it would be good if you could give us some good analysis figures of, shall we say, a machine shop operation so that the production men who do not get figures should have some guidance as to what they are charged with. It is not known to all production men. I would also like you to tell us what in your opinion in an

average machine shop is the best form of allocation ; whether hourly machine rate, percentage on labour cost, or a departmental percentage. I think that will give us something to fight over. I know it is a contentious matter, but it is one which I think will help us considerably.

MR. ROSE : As far as the last point is concerned, I think it is more or less admitted nowadays that the machine-hour rate is really the most satisfactory method. It is the nearest approach to accuracy attainable, giving as it does a rate per hour for every class of machine and hand operation. It is a complicated thing to set up, certainly, and there are not a lot of firms who have the courage to work it out. Probably far the largest proportion of firms recover their oncosts by a percentage on the direct labour. There are some who do it on both the labour and the material, but I think on the whole far the greater proportion seem to work on the percentage of labour. My experience is that in the ordinary manufacturing engineering works 120 per cent. seems to be a constantly recurring figure to cover factory oncosts.

On the motion of Mr. Halliwell, a cordial vote of thanks to Mr. Rose was adopted.

# The Institution of Production Engineers.

## PAPERS SET AT THE GRADUATESHIP EXAMINATION, 1934.

### WORKS ORGANISATION.

SATURDAY, 7TH APRIL, 1934. (2-30 P.M.—4-0 P.M.)

Maximum Marks, 150.

*Candidates are required to answer Three questions only.*

1. Discuss the various factors to be considered in the selection of site and general construction of a new factory.

2. An original design from the drawing office may often be modified to lower the cost of production. Explain how a works might be organised to facilitate and carry out such changes of design.

3. Tabulate the items which should be covered by iron foundry costs, from the receipt of pattern to delivered casting, subdividing the labour costs according to the various operations.

4. Two four-year-old capstan lathes, which cost £250 each when new, produce parts in five minutes each; the weekly programme being 1,000 parts. It is proposed to replace these capstans by one auto lathe costing £600 and producing the parts in two minutes each. Calculate the recovery period for the increased capital outlay, assuming that the wage rate is 1s. 6d. per hour, and that the capstans can be transferred to other work. Choose a suitable rate of depreciation on the constant percentage system for the capstans.

5. A works is producing instruments, about 500 per annum of each of three types, for which additional fittings may be required. The concern is old established and the production methods require modernisation. A definite product such as a microscope, engine indicator, or the like may be assumed to define the problem. Outline the scope of the preliminary investigation.

6. Why is it sometimes necessary to generate power at a small works employing up to 300 hands when Corporation, or other electric power, is available? State two types of heat engines which are used for this purpose, and tabulate the points in favour of each.



7. State the functions of a planning engineer in a works employing 1,000 hands on a standard line. You may choose a small unit assembly to illustrate your answer.

### WORKSHOP PRACTICE AND PROCESSES.

SATURDAY, 7TH APRIL, 1934. (4-0 P.M.—6-0 P.M.)

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Maximum Marks, 200.

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*Candidates to answer Three questions only.*

1. Sketch a milling cutter suitable for cutting a groove 1-inch  $\times$   $\frac{1}{4}$ -inch in mild steel on a horizontal miller at a speed of 70 feet per minute. What type and size of machine would you use, how many cuts would be necessary, and what feed could you use?

2. Two hundred guides in cast iron are required as shown in the figure. A rod works in the  $\frac{3}{4}$ -inch hole and must be guided accurately, so the wings must be true with the  $\frac{3}{4}$ -inch hole, and the  $\frac{3}{8}$ -inch bolt holes must be accurately positioned. The other machining is merely for finish. Plan the machining operations.

3. The part shown in the figure is of cast iron and is machined all over. Give a sketch showing suitable dimensions for the castings. Sketch any jig you would use to hold this component.

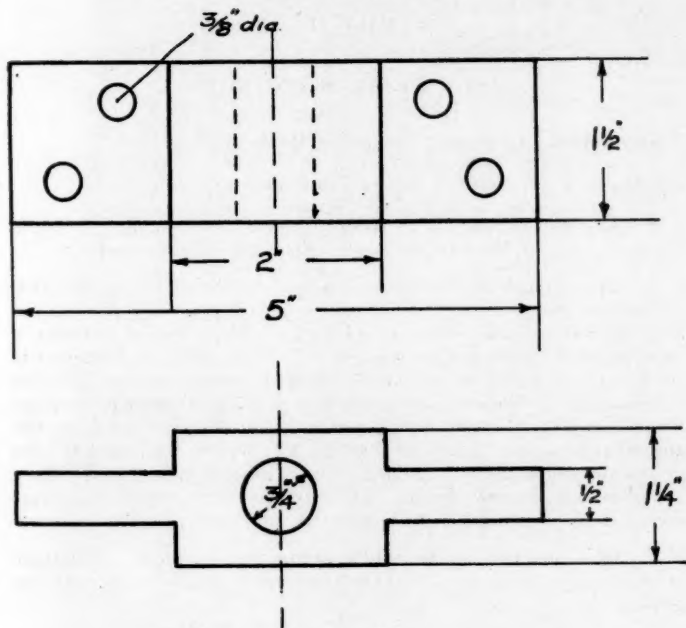
4. What factors limit the life of a cutting tool? How may each be controlled to ensure that the maximum amount of work is done by the tool? List them in what you consider their order of importance.

5. State the properties necessary for material from which cold pressings are to be made. How is the material likely to fail during pressing? What steps should be taken to minimise such failures? An example may be taken to assist the explanation.

6. Explain, with reference to grinding wheels, the terms Grit, Grade, Bond, Glazed Wheel, Loaded Wheel. In selecting a wheel for a particular job explain how consideration of the hardness of the material to be ground would influence the choice of wheel, stating why.

7. A keyway must be cut  $\frac{3}{8}$ -inch wide and  $\frac{1}{4}$ -inch deep, in a bore  $1\frac{1}{2}$  inches diameter and  $1\frac{1}{2}$  inches long. Describe how this would be produced: (a) by hand tools only; (b) in a workshop for a batch of ten; (c) for very large quantities.

GRADUATESHIP EXAMINATION, 1934



ESSAY AND INDUSTRIAL ECONOMICS.

SATURDAY, 7TH APRIL, 1934. (6-30 P.M.—8-30 P.M.)

PART I.

ESSAY.

Time allowed— $\frac{1}{2}$  hour. (50).

Select *one* only of the following subjects :

- (a) Describe the ideal practical training for a young production engineer.
- (b) Amplify some important factor of your First Essay already submitted to the Institution.
- (c) The functions and organisation of a Stores Department in relation to production.

PART II.

INDUSTRIAL ECONOMICS.

Time allowed—1½ hours. Maximum Marks, 150.

*Candidates are required to answer Three questions only.*

1. Explain briefly the terms "Capital," "Labour," "Trade Cycle," "Bill of Exchange," and "Elasticity of Demand."

2. The capital of a company was secured by the issue of 7,000 preference shares of £10 each, bearing seven per cent. per annum and 100,000 ordinary shares at £1 each. The preference interest is paid when it is covered by the profits for the year, and interest is paid on the ordinary shares when sufficient remains to pay three per cent. or more. The ordinary interest is the largest exact percentage which can be paid, three, four, five, etc. For the first five years the annual profits are £3,200, £5,000, £7,200, £8,300, and £9,400. No undistributed profits are carried forward during this period; they are placed in a reserve fund. Calculate the average rate of interest received for each kind of share and the total sum placed in reserve.

3. What are the functions of a production engineer? Illustrate your answer from any manufacture with which you may be acquainted.

4. In your reading of economics, state any ideas that may have occurred to you where you think that modern industrial conditions do not fit in with the theories enunciated by the authors.

5. Select any engineering product which is sold in large quantities, such as a motor car, cycle, typewriter, or the like. Show clearly how the selling price to the consumer is built up and the approximate percentage of the total for each of the charges.

6. Describe as fully as you can the chief elements included in the term "Overhead Charges."

7. A large quantity of bright drawn steel bar is required for a new product. Detail the complete procedure for the purchase, indicating who is responsible, from the issue of the original drawings to the payment for the material.

